

U.S. Application Serial No.: 10/628,925
Amendment After Final Dated August 10, 2005
In Response to Final Office Action Dated June 15, 2005

REMARKS

Claims 1-50 are in this application.

Claim 32-50 had been previously canceled without prejudice or disclaimer because they were drawn to a non-elected invention.

Applicants gratefully acknowledge the allowability of claims 6 and 10-14 if written in independent form including all the limitations of the base claim and any intervening claims.

Claim 6 has currently been canceled and its contents incorporated into claim 1. Thus, claim 1, as amended, is equivalent to re-writing claim 6 in independent form including all the limitations of the base claim and any intervening claims. Therefore, claim 1, as amended, also allowable.

Claims 1-5 and 7-31 are currently pending in this application.

Claims 1-5, 7-9, 15-19, 21, and 25-31 have been rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 6,265,780 to Yew et al., herein after "Yew."

Claims 1-5 and 15-19, 21, and 25-31, distinguish over Yew as follows:

(1) The electrical interconnect structure according to claim 1 has:
a first low k or ultra low k dielectric layer;
a low k CMP protective layer disposed on the first low k dielectric layer;
and

a CVD hardmask/CMP polish stop layer;
wherein said low k CMP protective layer is covalently bonded to said first low k dielectric layer.

The structure described by Yew does not have a low k CMP protective layer is **covalently bonded to the first low k dielectric layer**, as the Final Office Action has indicated through the allowability of claim 6, now canceled and re-written in independent form as claim 1. Accordingly, claim 1, and the claims depending directly or indirectly therefrom, are also allowable.

Yew does not describe any materials that can covalently bond to form improved adhesion. The materials listed by Yew as the first organic dielectric material and as the etch stop layer do not have the necessary chemical structure to form covalent bonds between the materials.

There is no teaching or disclosure in Yew that the first organic dielectric material and any of the other materials they list for etch stop layers forming covalent bonds.

The structure defined by the instant claims further differ from structures described by Yew in the following aspects:

- (1) In the structure described by Yew, the protective layer goes on the etch stop layer, not directly on the first dielectric layer, as is the case in the instantly claimed invention (see claim 1);
- (2) The low k protective layer 208 described by Yew is never in contact with CMP. For example, Figure 2E shows a metallized structure just after CMP.

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In the structure described by Yew, the only materials near the top that could be exposed to CMP are 214, which is described by Yew as being "a high-K inorganic dielectric material" (see column 4, lines 47-50), and 216, which is described by Yew as being "a second photoresist" (see column 4, lines 50-57). However, neither 214 nor 216 is a low k dielectric material.

Accordingly, the structures described by Yew are entirely different than the instantly claimed structures;

(3) In the instantly claimed invention, the protective layer is a CMP protective layer, not an etch protective layer. The protective layer in the final interconnect structure is never exposed to Etch, except in the lines and vias where it is completely removed by etch; and

(4) The protective layer described by Yew is a high dielectric constant material, rather than the low dielectric constant layers in the instantly claimed invention.

Clearly, Yew does not contemplate forming covalent bonds between these materials. To form chemical bonds with the organic dielectric layer, a reactive organic functional group is required in the inorganic layer. The structures described by Yew clearly do not have reactive organic functional groups in the inorganic layer. Thus, the structures described by Yew are entirely different from the instantly claimed structures.

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Therefore, the rejection of claims 1-5, 7-9, 15-19, 21, and 25-31 under 35 U.S.C. 102(b) as being anticipated by Yew should be withdrawn and claims 1-5, 7-9, 15-19, 21, and 25-31, and the claims directly or indirectly depending therefrom, should be allowed.

Claims 20 and 22-24 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Yew in view of U.S. Patent No. 6,683,002 to Chooi et al., herein after "Chooi."

The structure described by Yew does not have a low k CMP protective layer is **covalently bonded to the first low k dielectric layer**, as the Final Office Action has indicated through the allowability of claim 6, now canceled and re-written in independent form as claim 1. Claim 1, as amended, and the claims depending directly or indirectly therefrom, are also allowable.

Claims 20 and 22-24 depend from claim 1 and, as such, they have all the features and limitations of claim 1. Accordingly, claims 20 and 22-24 are also allowable.

Neither Yew nor Chooi describe any materials that can covalently bond to form improved adhesion. The materials listed by Yew as the first organic dielectric material and as the etch stop layer do not have the necessary chemical structure to form covalent bonds between the materials. There is no teaching or disclosure in Yew or Chooi that the first organic dielectric material and any of the other materials they list for etch stop layers forming covalent bonds.

The Yew and Chooi disclosures, either taken alone, or taken in combination, still lack the limitation that the low k CMP protective layer is **covalently bonded to the first low k dielectric layer**, as defined by claim 1.

The structure defined by the instant claims 20 and 22-24 further differs from the structures described by Yew and Chooi as follows:

(1) In the structure described by Yew, the protective layer goes on the etch stop layer, not directly on the first dielectric layer, as is does in the instantly claimed invention (see claim 1).

The same deficiency exists in Chooi. Thus, the combination of Yew and Chooi still does not describe a CMP protective layer.

(2) The low k protective layer 208 described by Yew is never in contact with CMP. For example, Figure 2E shows a metallized structure just after CMP. In the structure described by Yew, the only materials near the top that could be exposed to CMP are 214, which is described by Yew as being "a high-K inorganic dielectric material" (see column 4, lines 47-50), and 216, which is described by Yew as being "a second photoresist" (see column 4, lines 50-57). However, neither 214 nor 216 is a low k dielectric material.

The same deficiency exists in Chooi. Chooi describes using a porous dielectric layer in an interconnect structure but Chooi does not describe a porous low k dielectric layer that is exposed to CMP or acts to protect another low k layer from any damage from CMP. The only layer exposed to CMP in Chooi is layer 22, which is described as a cap. This layer is not low k or porous and is much thicker than the instant protective layer (see column 3, lines 60-65):

Finally, a cap layer 22, which is also optional, can be formed on dielectric layer 20. The cap layer is preferably composed of silicon nitride, silicon oxynitride, silicon carbide or boron nitride and most preferably silicon nitride. The cap layer preferably has a thickness of between about 500 and 5,000 Å.

The only materials near the top that could be exposed to CMP are those referred to as 22, and described by Chooi as being "silicon nitride, silicon oxynitride, silicon carbide or boron nitride," which are not porous or low k materials. The combination of Yew and Chooi still does not describe a porous or low k dielectric material that is exposed to CMP or acts to protect another low k layer from any damage from CMP.

(3) In the instantly claimed invention, the protective layer is a CMP protective layer, not an etch protective layer. The protective layer in the final interconnect structure is never exposed to Etch, except in the lines and vias where it is completely removed by etch. This feature is not described in Yew.

Chooi does not describe a CMP protective layer, it only describe that the dielectric layer may be porous. Thus, the combination of Yew and Chooi still does not describe a porous or low k dielectric material that is exposed to CMP or acts to protect another low k layer from any damage from CMP.

(4) The protective layer described by Yew is a high dielectric constant

material, rather than the low dielectric constant layers defined by the instantly claimed invention. Chooi does not describe a protective layer. The only layer that could be exposed to CMP in Chooi is layer 22, which is not porous or low k.

(5) Yew does not describe any materials that can covalently bond to form improved adhesion. The materials listed by Yew as the first organic dielectric material and as the etch stop layer do not have the necessary chemical structure to form covalent bonds between the materials. There is no teaching or disclosure in Yew that the first organic dielectric material and any of the other materials they list for the etch stop layer forming covalent bonds. Clearly, Yew does not contemplate forming covalent bonds between these materials. To form chemical bonds with the organic dielectric layer, a reactive organic functional group is required in the inorganic layer.

The same deficiency exists in Chooi. The structures described by Yew do not have reactive organic functional groups in the inorganic layer. Thus, the structures described by Yew are entirely different from the instantly claimed structures.

In view of the above, Yew and Chooi, either alone or in combination, do not possess all the elements of the interconnect structure defined by claim 1.

Even if Yew and Chooi are combined, the resulting structure would still be deficient in describing the interconnect structure as defined by claim 1.

To establish a *prima facie* case of obviousness, all the elements of a claim must be present or described in a cited references with a suggestion to modify the references, to provide motivation to combine (see MPEP § 2142 and In re

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Rouffet, 47 USPQ 2d at 1457-1458) and arrive at the claimed invention, provided that a person of ordinary skill in the art would have a reasonable expectation of success.

Yew and Chooi, either alone or in combination, do not possess all the elements of the interconnect structure defined by claim 1. There is no teaching or suggestion in either Yew or Chooi regarding how to modify one or more elements of the other to produce an interconnect structure as defined by claim 1. Further, there is no teaching or suggestion in Yew and Chooi **in combination** regarding how to produce an interconnect structure having **all the limitations** required by claim 1.

Without such a teaching or suggestion to modify the reference, a person of ordinary skill in the art would not have motivation to combine the references.

Further, even if the references were combined, a person of ordinary skill in the art would not have a reasonable expectation of success at arriving at the claimed invention, because Yew and Chooi, in combination, still do not describe an interconnect structure having **all the elements** defined by claim 1.

Accordingly, the criteria for establishing a *prima facie* case of obviousness have not been met (see MPEP 2143, citing *In Re Vaeck*, 947 F.2d 488, 20 USPQ 2d 1438 (Fed. Cir. 1991)) so that the combination of the cited art does not render the instant claims obvious.

Therefore, the rejection of claims 20 and 22-24 under 35 U.S.C. 103(a) as being unpatentable over Yew in view of Chooi should be withdrawn and claims 20 and 22-24 should be allowed.

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In view of the foregoing, all currently pending claims, namely claims 1-5 and 7-31, are patentable over the cited art for at least the reasons set forth herein above.

Accordingly, reconsideration of this application, withdrawal of the rejections and allowance of claims 1-5 and 7-31 is respectfully requested.

Respectfully submitted,

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